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Machine tools — Lubrication systems

Machines-outils — Installations de lubrification

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5170 was developed by Technical Committee ISO/TC 39, *Machine tools*, and was circulated to the member bodies in January 1976.

It has been approved by the member bodies of the following countries :

Australia	Italy	Spain
Belgium	Japan	Switzerland
Bulgaria	Korea, Dem. P. Rep. of	Turkey
Czechoslovakia	Mexico	U.S.A.
France	Netherlands	U.S.S.R.
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Sweden
United Kingdom

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Machine tools — Lubrication systems

1 SCOPE AND FIELD OF APPLICATION

This International Standard establishes

- a classification of the various lubrication systems for machine tools;
- specifications regarding the components;
- control and monitoring methods;
- system lay-out practice;
- system maintenance.

It is intended to give guidance to manufacturers and users of machine tools, with a view to rationalizing the method of lubrication.

This International Standard may be applied to other general types of machinery.

2 REFERENCES

ISO 1219, *Fluid power systems and components — Graphic symbols.*

ISO 3498, *Lubricants for machine tools.*[1]

ISO 5169, *Machine tools — Presentation of lubrication instructions.*[2]

3 DEFINITIONS

For the purposes of this International Standard, the following definitions apply.

3.1 lubrication point : The point where lubricant is fed in order to lubricate a bearing surface.

3.2 action point : Any point in a lubrication system where, in general, an external action should be carried out to ensure the correct operation of the system. For example, filling with lubricant (nipples or reservoirs, etc.), actuation of a lever, etc.

4 METHODS OF LUBRICATION (See the annexes)

4.1 Total loss system

The lubricant is supplied to the lubrication point and after use it goes to waste.

4.2 Circulating system

The lubricant is fed to the lubrication points and is then returned to the reservoir for further use.

4.3 Hydrostatic system

Fluid lubrication in which surfaces, moving or stationary, are separated by a fluid introduced between them by an external pressure.

5 TYPES OF SYSTEM (See the annexes)

5.1 Individual point lubrication

Individual point lubrication is that type of lubrication carried out by manual portable equipment.

Individual point lubrication may be used on simple machines or where there are only about 10 points requiring lubrication at intervals of approximately 50 h.

5.2 Centralized system

A centralized system is one in which two or more lubrication points on a machine are served with the same lubricant from a common source. Centralized systems are particularly applicable if the machine is intended for mass production or if the machine is complex or expensive.

Centralized systems may be

a) manually operated;

b) semi-automatic in operation, pumps being manually actuated;

c) fully automatic in operation.

1) At present at the stage of draft. (Revision of ISO/TR 3498-1974.)

2) At present at the stage of draft.

5.2.1 *Restrictor type*

In restrictor-type systems, the quantity of lubricant distributed is proportional to the pressure and to the size of the orifice.

5.2.2 *Single-line type*

In single-line type systems, the lubricant is supplied under intermittent pressure (direct or delayed) through single-line pipework to the injectors which feed the lubricant to the various lubrication points. It is a characteristic of the single-line type that the main pipework must be de-pressurized after the lubrication shot. This is necessary for the functioning of the metering devices.

5.2.3 *Two-line type*

In two-line type systems, the lubricant is alternately forced via a directional control valve to each of two main pipe lines to which metering devices are connected at intervals. The metering devices are operated by the alternate rise and fall in lubricant pressure in the main lines, allowing the metered quantity of lubricant to be delivered to the lubrication point.

5.2.4 *Multi-line type*

In multi-line type systems, the lubricant is delivered in metered quantities from a number of outlets of one pump. An individual pipe runs from each outlet to the respective lubrication point.

5.2.5 *Progressive plunger type*

In systems of this type, the quantity of lubricant is supplied to the lubrication points by metering devices, pressure operated, in a predetermined sequence.

5.2.6 *Oil mist/Aerosol type*

In this type of system, minute particles of lubricating oil, suspended in an air stream, are generated at a central point, and piped to the lubrication points where the oil mist is converted back to useful oil through specially designed devices.

5.2.7 *Combined system*

Combinations of the various types of system described above are possible if required by the machine design.

6 SPECIFICATION OF COMPONENT PARTS

6.1 Nipples and individual lubricators

Nipples shall be of the direct-injection type (preferably of hydraulic type) with portable pump. Nipples and individual lubricators shall be screwed into holes threaded in accordance with International Standards.

6.2 Reservoirs

6.2.1 *Oil reservoirs*

6.2.1.1 The reservoir shall always have a capacity such that

a) For total loss systems :

Refilling shall be only necessary after a minimum of 50 working hours.

b) For circulating systems :

Draining and cleaning shall only be necessary after a minimum of 1 000 working hours.

Reservoirs shall be of sufficient capacity to contain all the fluid used in the system and to dissipate excess heat generated, unless fitted with devices (i.e. heat exchanger) to cool the lubricant.

The reservoir shall be marked with the normal working, maximum and minimum levels and the total reservoir capacity shall be clearly indicated.

6.2.1.2 All reservoirs with capacities greater than 0,5 l (31 in^3) shall be fitted with a visual level indicator so that the actual level in the tank can be easily checked at any time from the maximum to the minimum level.

6.2.1.3 In an automatic centralized total loss system, an alarm signal control of the low level is needed.

6.2.1.4 In circulating systems, means shall be provided to stop operation of the machine when the lubricant falls below an acceptable level. (See 6.8.4.)

6.2.1.5 All reservoirs with capacities greater than 3 l (0.793 gal U.S.) must be fitted with a mesh strainer in the filler hole fine enough but of adequate size to permit rapid filling consistent with the viscosity of the lubricant. It should have a cap to prevent the accidental introduction of foreign matter. An air vent shall be provided and this may be part of the cap or cover.

6.2.1.6 The filter cap shall be tamperproof and fitted with a device to prevent its loss.

6.2.1.7 All reservoirs of a capacity greater than 3 l (0.793 gal U.S.) shall have a tamperproof drain plug to ensure rapid and complete draining. Thread shall conform to International Standards.

6.2.1.8 Protective coatings for the internal surfaces shall be compatible with lubricants.

6.2.1.9 Reservoirs shall have an accessible opening to permit internal cleaning and maintenance.

6.2.1.10 In circulating-system reservoirs, the pipe ends shall be immersed in the oil below the minimum operational level.

In addition, the suction and return pipe ends shall be separated as much as possible to minimize the effect of foaming and/or of emulsion.

6.2.1.11 If electric heating is provided, the rating of the heating surface shall not normally exceed 12,5 kW/m^2 (1.16 kW/ft^2).

6.2.2 *Grease reservoirs*

6.2.2.1 Grease reservoirs shall be fitted with devices to ensure positive pump prime.

6.2.2.2 Reservoirs shall be fitted with means for allowing air to escape during filling.

6.2.2.3 All reservoirs with capacities greater than 0,5 l (31 in^3) shall be so designed that the actual level in the tank may be easily checked at any time from the maximum to the minimum levels.

6.2.2.4 The reservoir and the pump shall be integrally mounted.

6.2.2.5 Automatic systems shall have an alarm signal to indicate the low lubricant level.

6.2.2.6 The filler cap shall be tamperproof and fitted with a device to prevent its loss.

The filter connection shall incorporate a mesh strainer and the assembly shall permit rapid filling.

6.2.2.7 Large reservoirs shall be designed with adequate facilities for emptying and internal cleaning.

6.2.2.8 Protective coatings for the internal surfaces shall be compatible with lubricants.

6.3 Pumps

6.3.1 Pumps may have the following types of drive :

- electric;
- pneumatic;
- hydraulic;
- mechanical;
- manual.

6.3.2 Pumps may be of single- or multi-piston type, gear type, vane type or screw type.

6.3.3 The direction of rotation of the pump as well as the inlet and outlet ports shall be clearly indicated.

6.3.4 Plates showing the following data shall also be attached to the pump :

- name of manufacturer;
- model designation or identification number;
- serial number (where applicable).

6.4 Piping

Flexible or rigid piping may be used and shall have the following features :

6.4.1 *Flexible piping*

6.4.1.1 Flexible piping shall be chemically inert to lubricants.

6.4.1.2 Flexible piping shall have a mechanical strength consistent with the maximum system operating pressure.

6.4.1.3 Flexible piping shall be able to sustain accidental overpressures without altering lubrication.

6.4.2 *Rigid piping*

6.4.2.1 Rigid piping shall be made of scale-free steel, plastic materials or any other suitable material.

6.4.2.2 Where pipes are exposed to heat sources, galvanized pipes shall be avoided. In addition, if the pipes are in contact with cutting fluids containing active or uncombined sulphur, the use of copper pipes shall be avoided.

6.4.2.3 Inside diameters of pipes for grease shall not be less than 4 mm (0.157 in) for main lines and 3 mm (0.118 in) for feed lines.

6.4.3 *Oil mist/Aerosol systems*

In the case of oil mist/aerosol systems, all types of piping shall have smooth walls and fittings without a reduction of cross-sectional area.

6.5 Fittings

6.5.1 Fittings shall be selected to suit the system, the pressure and the types of piping used.

6.5.2 Threads shall conform to International Standards.

6.6 Filters

6.6.1 Whatever the type of system, the lubricant shall not contain impurities which may damage the machine tool or the system components.

6.6.2 In the case of circulating or hydrostatic systems, it is advisable to provide a filter system (strainer or integral at the outlet of the pump) to prevent the lubricant in the reservoirs from becoming contaminated, and in extreme cases to provide connections on the reservoir for centrifuging.

6.6.3 The filters shall not permit the passage of impurities and, therefore, means shall be provided to indicate that the filter is blocked.

6.7 Metering devices

The nominal quantity of lubricant or, in the case of adjustable devices, the maximum quantity delivered at each stroke by volumetric devices shall be shown on the device.

6.8 Control and safety devices

6.8.1 Control systems may be

- continuous;
- programmed intermittent independent of machine cycle;
- cyclic intermittent dependent on machine cycle.

6.8.2 Each system shall be fitted with control devices which indicate abnormal lubrication system pressures.

6.8.3 Where required, devices may also be fitted which will indicate other system defects and will localize them.

This may particularly apply to important machines where downtime is long and expensive.

6.8.4 Where necessary, means may be provided to stop the machine, after the indication of a failure has been given, so as to avoid serious damage to the machine, the tooling and the operators.

6.8.5 Pressure gauges used in lubrication systems shall be fitted with dampers or shall be of the oil-bath type.

6.9 Electric motors and electrical equipment

Electric motors and all electrical equipment shall conform to the appropriate IEC Publications.

7 SYSTEM COMPONENTS — LAYOUT PRACTICE

7.1 Lubrication systems

7.1.1 System design shall ensure the complete separation of cutting fluid and lubrication systems.

7.1.2 Hydraulic and lubrication systems shall only be combined when the oil selected is suitable for both applications, and provided that care is taken to remove impurities.

7.2 Nipples and individual lubricators

7.2.1 These shall be placed in easily accessible positions.

7.2.2 Points being supplied with the same lubricant may advantageously be mounted on a common block which can be easily reached and shall be situated between 500 mm (20 in) and 1 200 mm (48 in) above working level.

7.2.3 The use of wick-oiling, drip-feed, Stauffer and other special types of lubricator is to be discouraged.

7.3 Reservoirs

7.3.1 Manually filled reservoirs shall be positioned with the filler connection easily accessible and situated between 500 mm (20 in) and 1 200 mm (48 in) above working level.

7.3.2 Drain plugs shall be easily accessible and allow the reservoir to be completely and easily drained.

Where openings are provided for internal cleaning, they shall be easily accessible.

7.3.3 Level indicators shall be provided which are visible to the person responsible for filling the reservoir.

7.3.4 For filling the reservoir with grease, the use of an ancillary pump fitted with suitable strainers is highly advisable.

7.4 Pumps

7.4.1 Pumps may be mounted inside or outside the reservoir but shall be adequately protected and readily accessible for adjustment and maintenance purposes.

7.4.2 Manual pumps shall be positioned in such a manner that they may be easily operated.

7.5 Piping

7.5.1 Piping shall be properly fastened, adequately protected, and positioned so that it does not obstruct or render inaccessible other machine components.

7.5.2 Pipework shall not be subject to stress other than that due to internal pressure, and shall not be used to support large system components.

7.5.3 All open pipe ends shall be suitably covered and sealed throughout storage, transport and assembly periods and shall be thoroughly cleaned before running.

The use of sealing compounds is to be discouraged.

7.5.4 Pipework layout shall be such that losses of pressure are limited, and that there is no excessive restriction to flow.

7.5.5 In circulating systems, return pipework shall have an adequate cross-sectional area, larger than the feed lines.

7.5.6 In oil mist/aerosol systems, all main pipework shall be installed so that it slopes back to the reservoir, and means shall be provided to prevent entrapment of any residual oil, for example by drilling a hole about 1 mm (0.04 in) diameter at the bottom of down loops. If flexible pipes are used, down loops shall be avoided.

7.5.7 Sharp bends on pipework shall be avoided whenever possible.

7.5.8 Flexible hoses shall be installed so as to avoid any excessive torsional stresses.

7.6 Fittings

All fittings shall be positioned so that they are accessible.

7.7 Filters

7.7.1 All filters shall be located so that they are easily accessible.

7.7.2 Filters shall be mounted to prevent air entrapment.

7.7.3 Grease strainers should be installed on the delivery side of the pump.

7.8 Metering devices

7.8.1 Each metering device outlet shall supply only one lubrication point except in the case of oil mist/aerosol systems.

7.8.2 Metering devices shall be situated as close as possible to the lubrication point.

7.8.3 Adjustable metering devices shall be easily accessible.

7.9 Control and safety devices

7.9.1 All visual indicators shall be positioned where they can be easily seen by the operator, for example pressure gauges, level indicators, flow meters, etc.

7.9.2 In circulating systems fitted with restrictor-type metering devices, it is desirable to fit visual flow indicators.

7.10 Action points

All action points shall be suitably labelled complying with ISO 5169.

8 LUBRICANTS

8.1 Lubricants shall be selected by the machine tool manufacturer from ISO 3498.

8.2 The machine tool manufacturer shall take special care to avoid any accidental mixing of coolants, cutting fluids and lubricants.

9 SAFETY OF LUBRICATION PERSONNEL

All action points shall be easily accessible and situated so as not to cause a safety hazard.

If this is impossible, the personnel shall be protected by adequate guards in conformity with safety regulations.

10 DOCUMENTS TO BE SUPPLIED BY THE MACHINE TOOL MANUFACTURER

10.1 List of components together with details of the manufacturer's or supplier's part number and specification.

10.2 Lubrication instructions complying with ISO 5169 and details of amount of lubricant used on an hourly basis.

10.3 The method of system operation as defined in 6.8.1.

10.4 Instructions for operation and maintenance of the lubrication system.

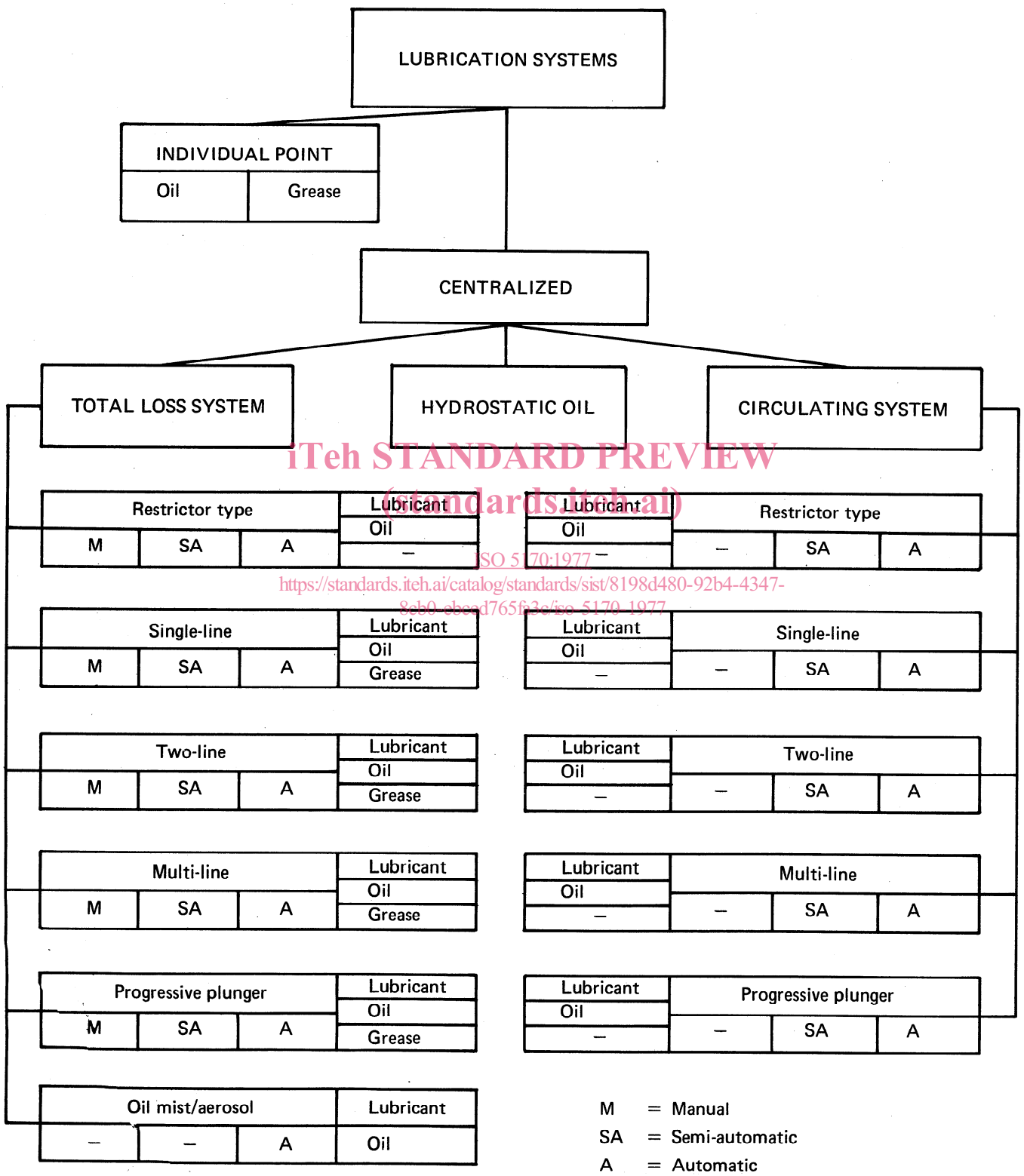
11 TESTING AND ACCEPTANCE

The system shall be in compliance with

- this International Standard;
- the stated performance characteristics;
- safety standards;
- any special requirements agreed between the supplier and the purchaser.

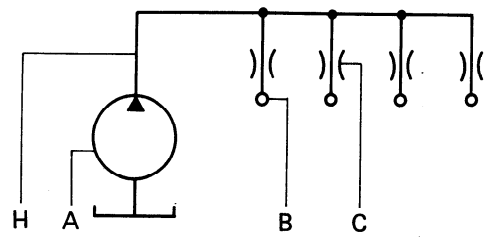
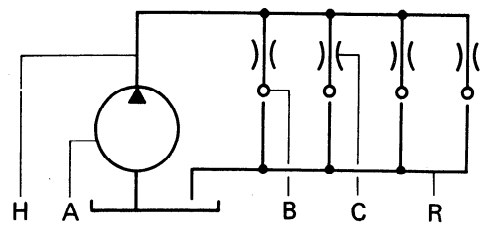
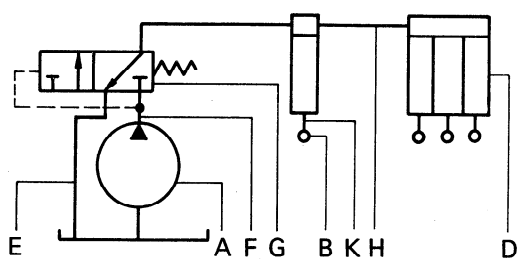
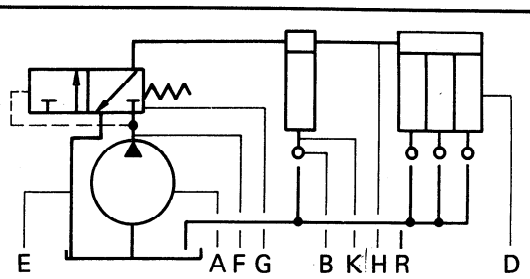
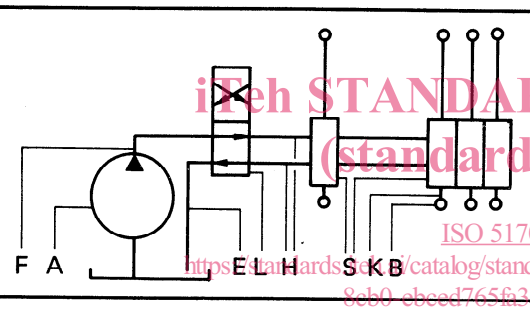
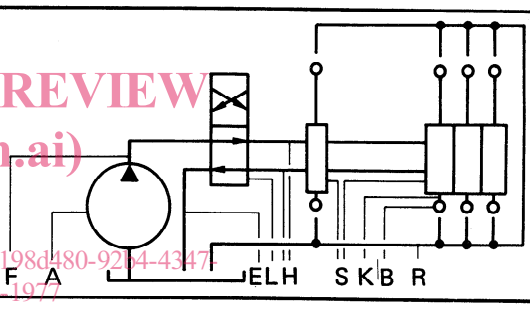
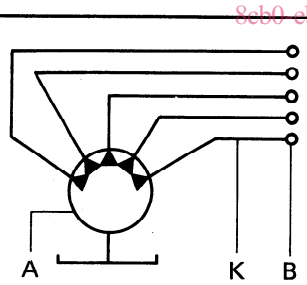
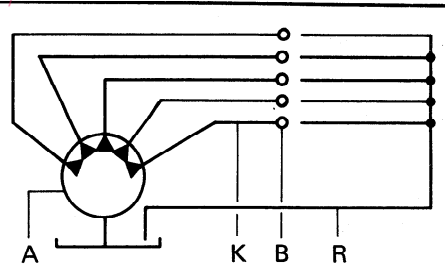
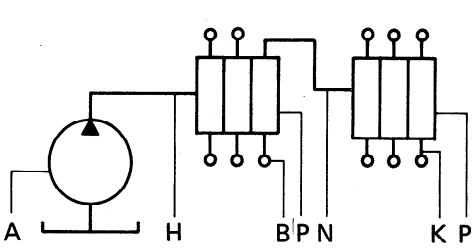
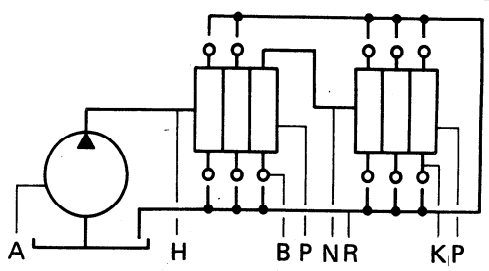
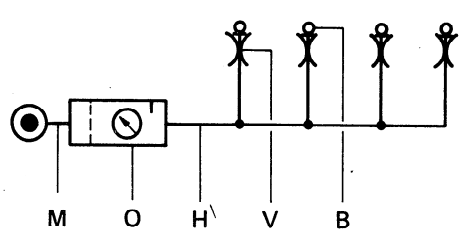
ANNEX A

CLASSIFICATION OF LUBRICATION SYSTEMS



ANNEX B

DIAGRAMS OF CENTRALIZED LUBRICATION SYSTEMS[1)]

	Total loss systems	Circulating systems
Restrictor system		
Single-line system		
Two-line system		
Multi-line system		
Progressive plunger system		
Oil mist/aerosol system		

Description

- A Pump with lubricant reservoir
- B Lubrication point
- C Restrictor
- D Single-line metering device
- E Relief line
- F Pressure line
- G Relief valve
- H Main line
- K Feed line
- L Directional control valve 4/2
- M Compressed-air line
- N Secondary feed line
- O Oil-mist lubricating unit
- P Progressive plunger metering device
- R Return line
- S Two-line metering device
- V Condenser

1) These diagrams are simplified and given as an example.